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SLIDES: Data Sharing and River Basin Modelling: From the Colorado to the Nile

Kevin Wheeler

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June 10, 2016

Data Sharing and River Basin Modelling: From the Colorado to the Nile

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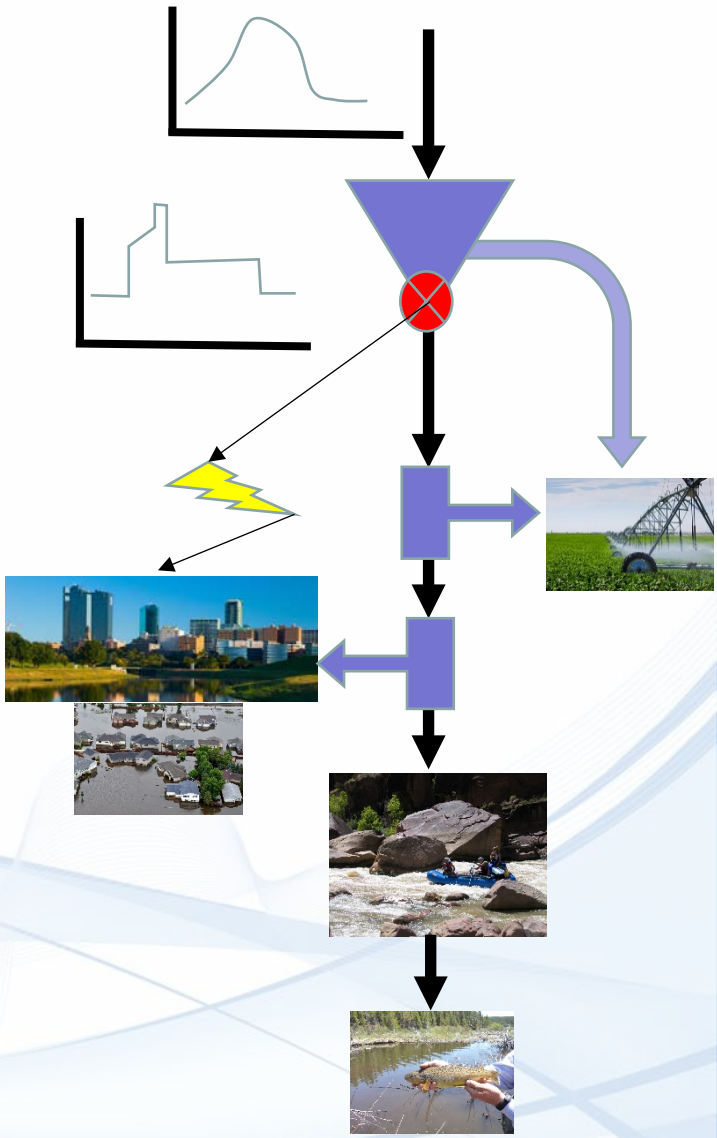
Outline

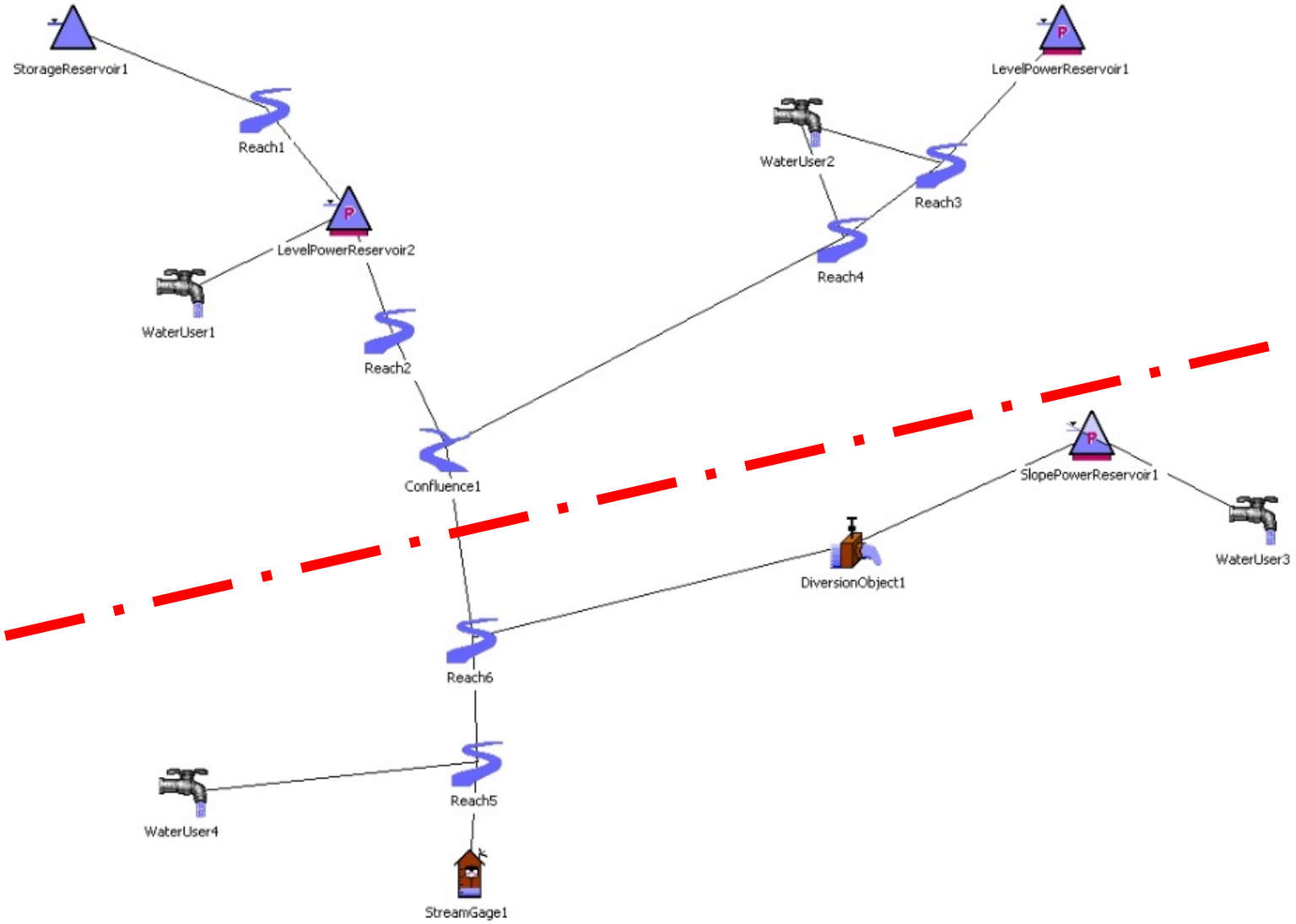
- Water Resource Systems Analysis
- Case Studies
  - Colorado River
  - Nile River

Typical Question Addressed

- How to operate a multi-objective reservoir
  - Agricultural, municipal, environmental, recreational, flooding, energy generation
  - Water quantity, water quality
  - Recommend reservoir operations (releases, reservoir levels), river flows, permissible diversions, etc.



Multiple Reservoir Coordination



Part II. Colorado River

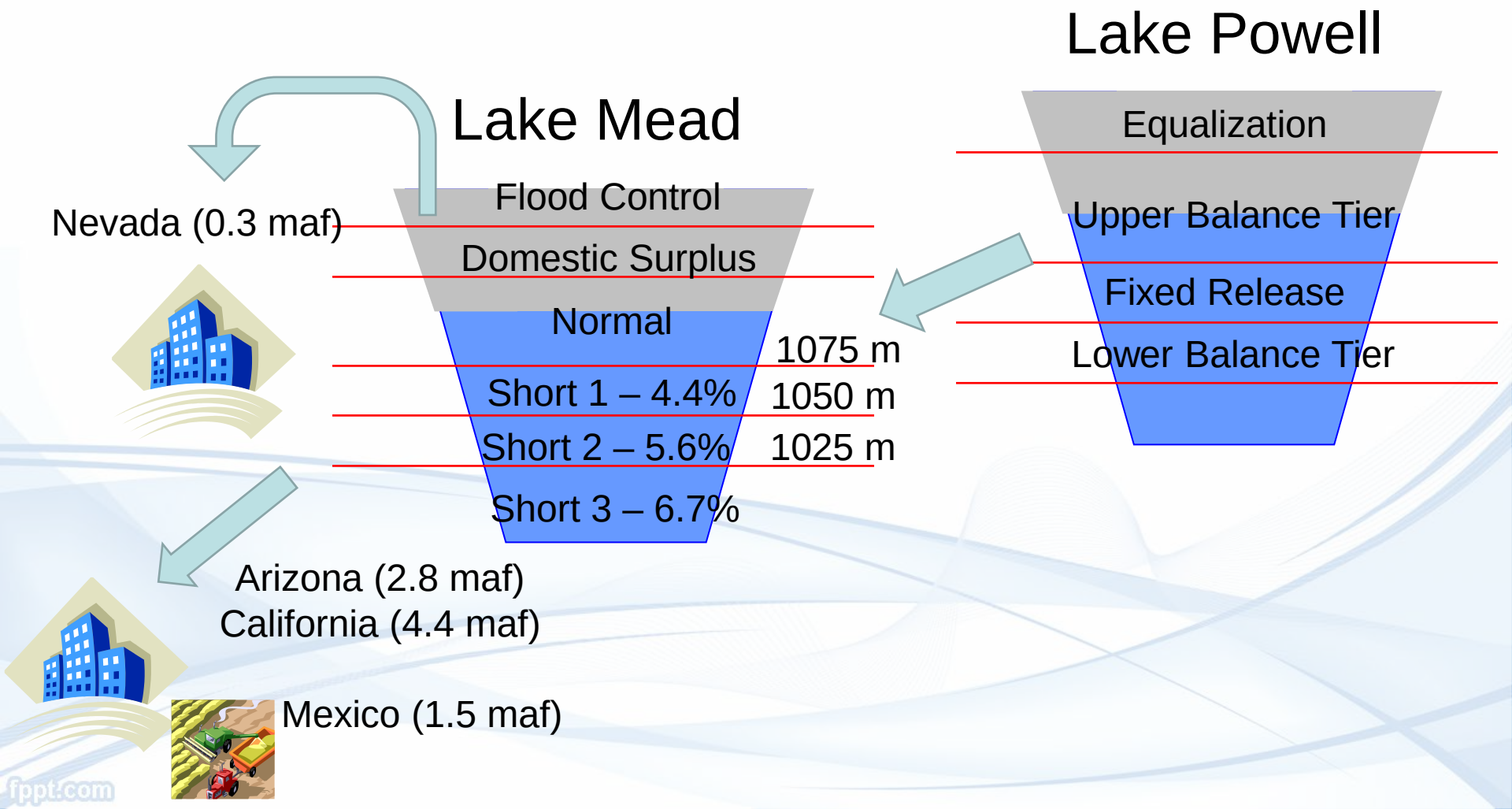
"Law of the River"

- ✓ **1922 - Colorado River Compact**
- ✓ **1928 - Boulder Canyon Project Act**
- ✓ **1944 – U.S. - Mexico Water Treaty**
- ✓ **1948 - Upper Colorado River Compact**
- ✓ **1964 - Arizona vs. California**
- ✓ **1973 - Minute 242 of Treaty with Mexico**
  - **Salinity Limitations**
- ✓ **2000 - Interim Surplus Criteria**
- ✓ **2007 – Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Mead and Lake Powell**
- ✓ **2012 - Minute 319 of Treaty with Mexico**
- ✓ **2012 – Colorado River Supply and Demand Study**

Colorado River Simulation System (CRSS)

- 1973
  - Developed by USBR
  - FORTRAN Model
  - ‘Black Box’ - Difficult to understand/edit
- 1990’s – 2000’s
  - Need for new policy exploration
  - Accessible to multiple stakeholders
  - Transparency is important
  - Development of RiverWare modelling platform
    - USBR
    - Tennessee Valley Authority (TVA)
    - Army Corps of Engineers

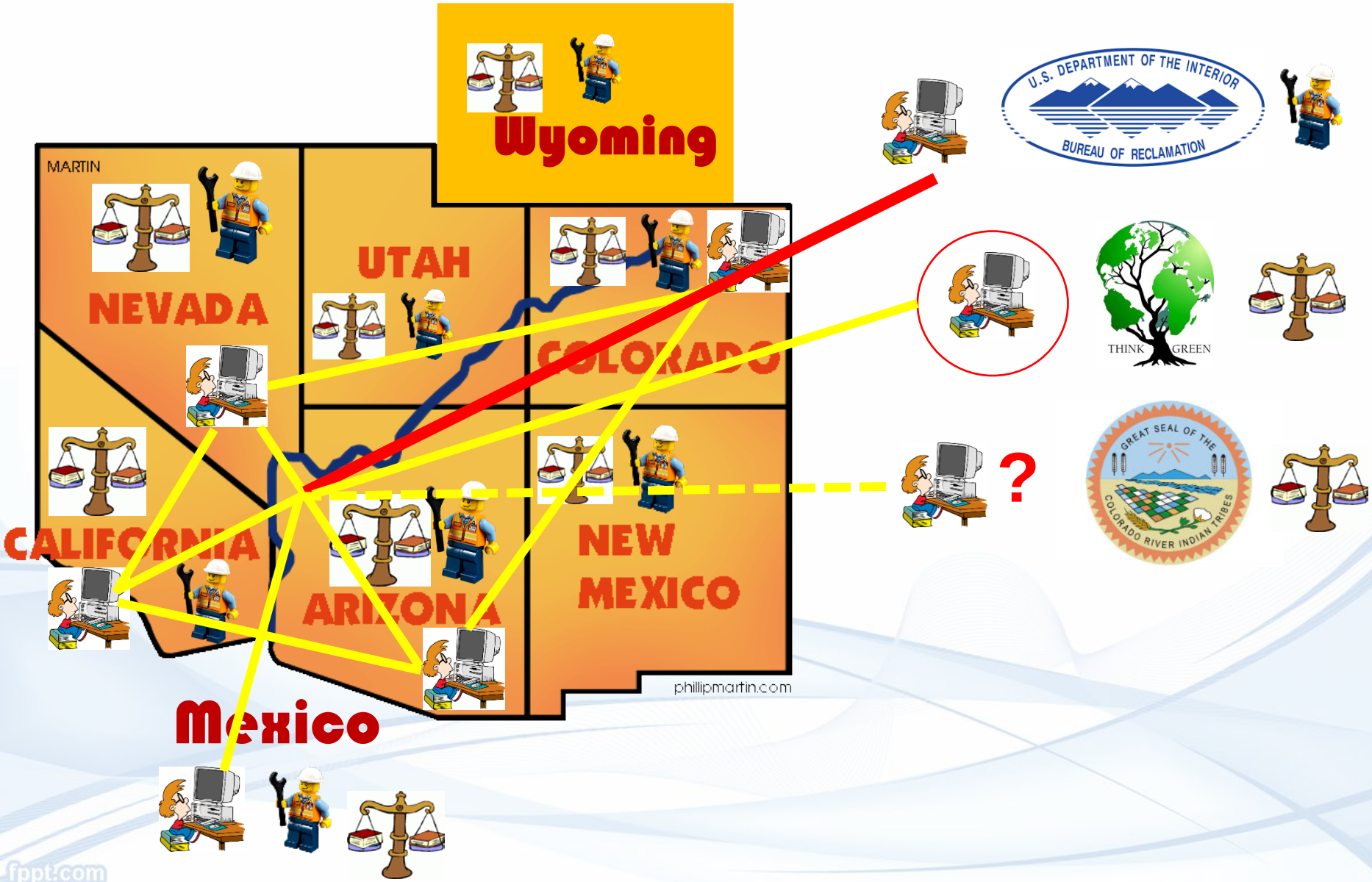
2007 - Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead



USA-Mexico Treaty
Minute 319

- Shortage sharing
- Surplus sharing
- ICMA
- Delta Pulse flow

Expanding Fields of Expertise



Lessons Learned

- Common analytical platform is critical
- Access to stakeholders
- Early stakeholder involvement
  - Active encouragement
  - Enhance technical capacity
- System-wide understanding = find solutions

Models in Transboundary Negotiations

- Who develops a model?
- Who understands the model?
- Who can use the model?
- Who trusts a model?
- Who ‘maintains’ the model?

Part III. The Nile

Grand Ethiopian Renaissance Dam

Comparison

Colorado River	Nile River
40 Million People	238 Million
7 States + 2 Countries	11 Countries
18.5 BCM/year	82.5 BCM/year
462 m^3/person	347 m^3/person
#1 Use = Agriculture	#1 Use = Agriculture
Management Agreements	
1922 Colorado Compact	1902 Contested treaty between Ethiopia and the United Kingdom
1944 USA – Mexico Treaty	1929 Between British controlled regions
1946 Upper Colorado Compact	1959 Egypt-Sudan Agreement
1964 Arizona vs. California … etc.	NO BASIN WIDE AGREEMENTS

Main Nile

Courtesy of Nile Basin Initiative

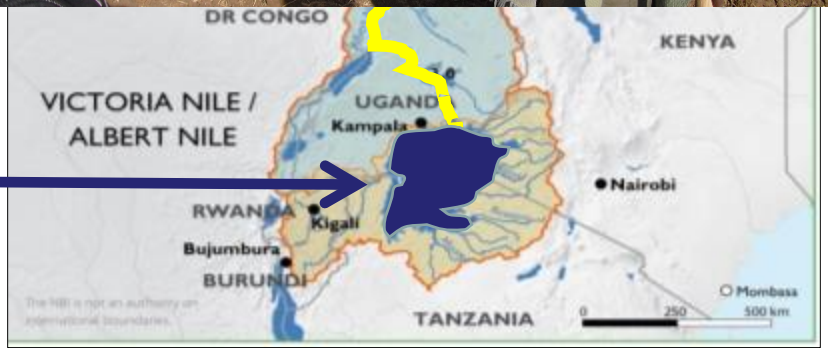
White Nile

Blue Nile

Lake Tana

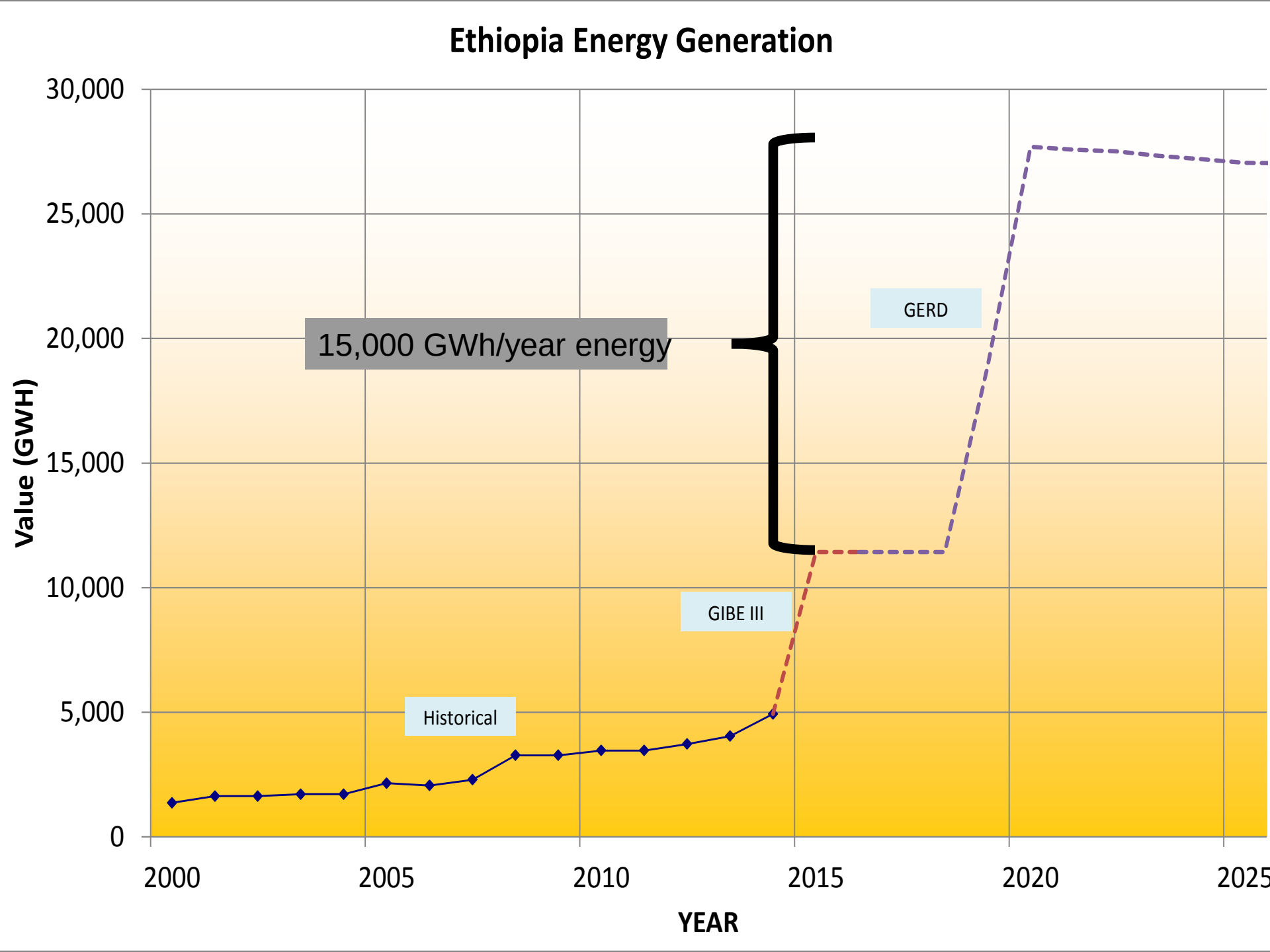
Sudd Wetland

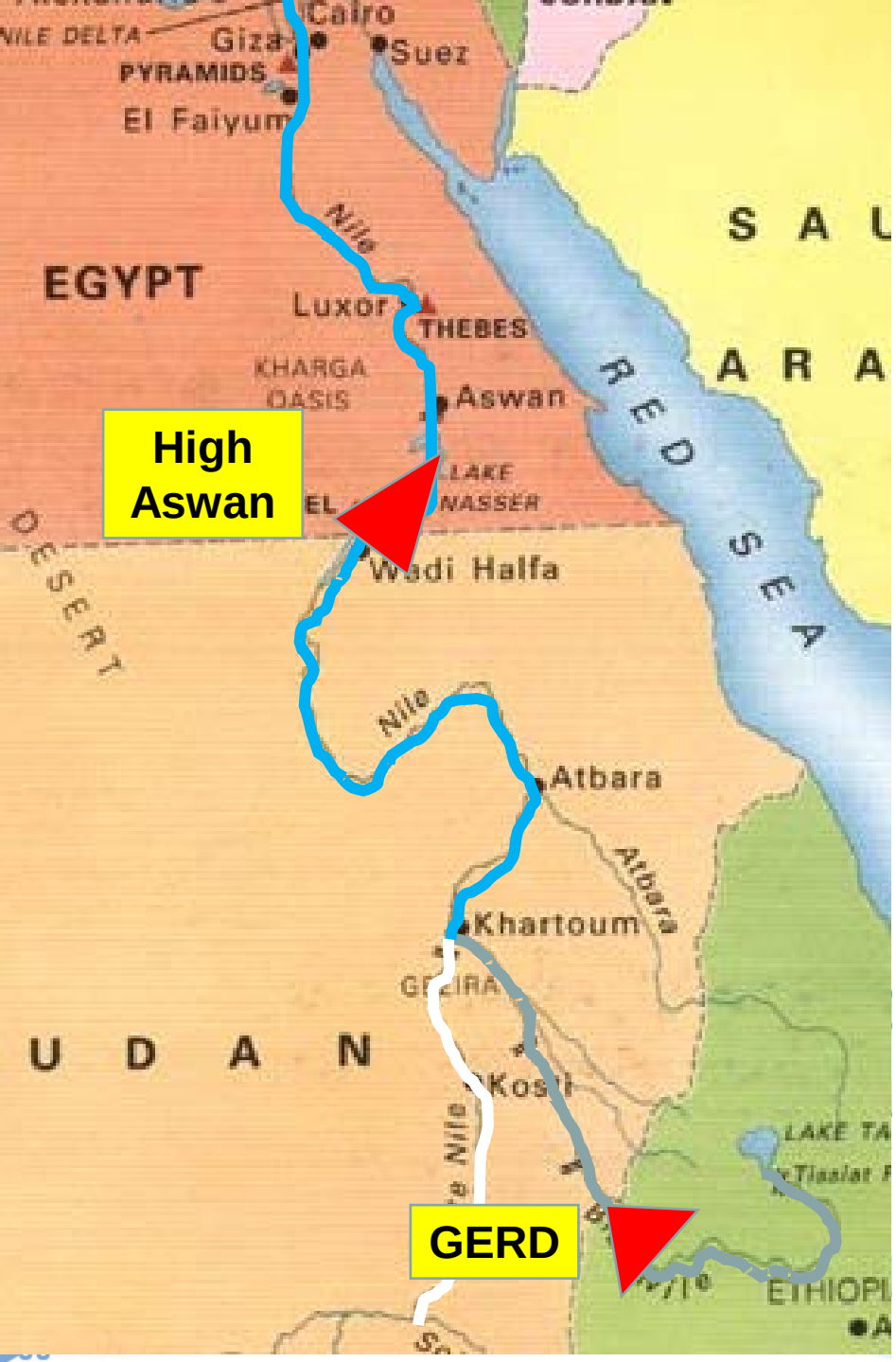
Victoria/Albert Nile



Lake Victoria

Grand Ethiopian Renaissance Dam (GERD)


Ethiopia Energy Generation
30,000
25,000
20,000
15,000
10,000
5,000
0
Value (GWH)
15,000 GWh/year energy
GERD
GIBE III
Historical
2000
2005
2010
2015
2020
2025
YEAR



GERD Timeline

- 1964 USBR Study “Border” Site
- Nile Basin Initiative (1999-Present)
- March 2011 – Project Announced
  - Design and impact assessments not released to the general public
- 2012-2013 –International Panel of Experts (IPoE) Convened
  - Review Existing Documentation
  - Completed May 2013
  - Leaked March 2014
- Ongoing Trilateral Negotiations
- March 2015 - “Declaration of Principles” Agreement Signed
- French and Dutch consultants selected to provide recommendations
- Dutch consultant withdraws

Potential Effects of the GERD to Sudan

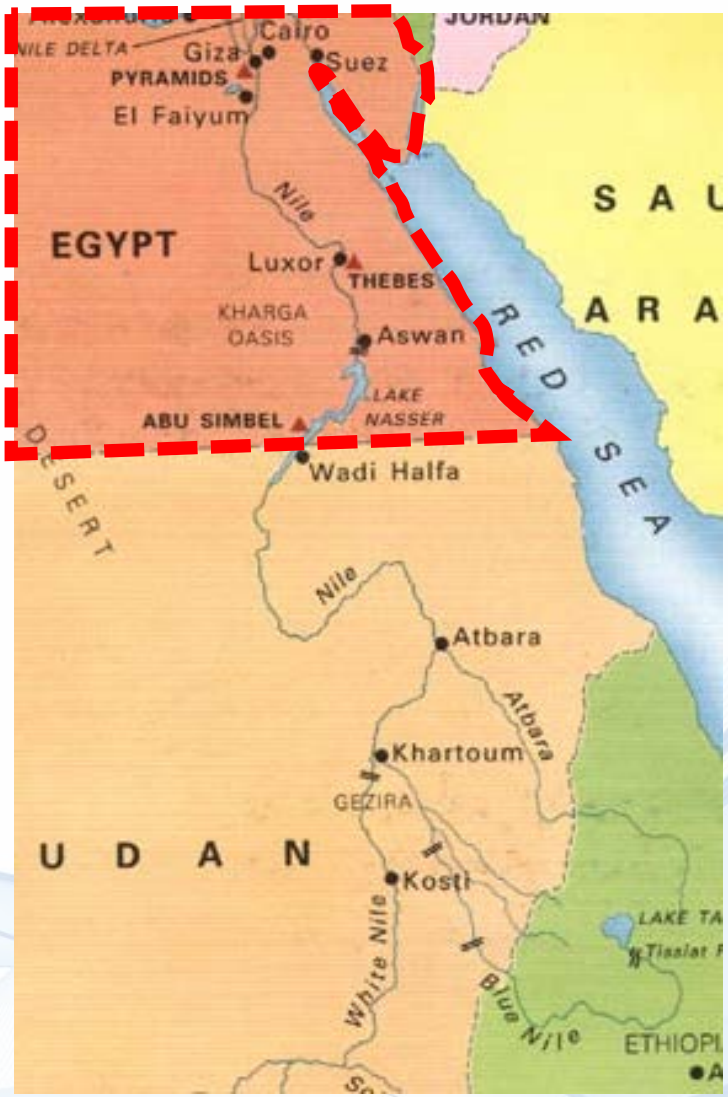
- Potential Benefits
  - + Increased Control of Flows –> Increased Irrigation Potential
  - + Decreased Sediment –> Reduced Siltation of Infrastructure
  - + Improved Flood Risk Management
  - + Improved Hydropower Generation (Uplift)

- Potential Risks
  - – Decreased Control of Flows –> Loss of Flood Agriculture
  - – Decreased Sediment Loading –> Loss of Nutrient Transport
  - – Modified Natural Flows –> Alteration of Ecosystems

Potential Effects of the GERD to Egypt

- Potential Benefits
  - + Increased Upstream Storage – Increased Water Security
  - + Decreased Sediment – Reduced Siltation of Infrastructure
- Potential Risks
  - – Decreased Control of Flows – Decreased Water Security
  - – Decreased Hydropower Generation

Dam Operations becomes the Negotiation Space

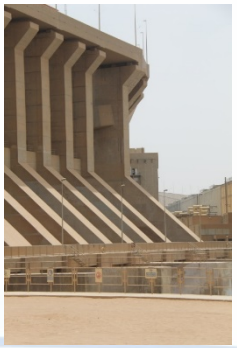


Critical Issues

- No agreement on coordination with downstream countries
- No known Power Purchase Agreements
- Unknown impact to flood recession agriculture in Sudan
- No common analytical platform
- Major filling begins in 2017

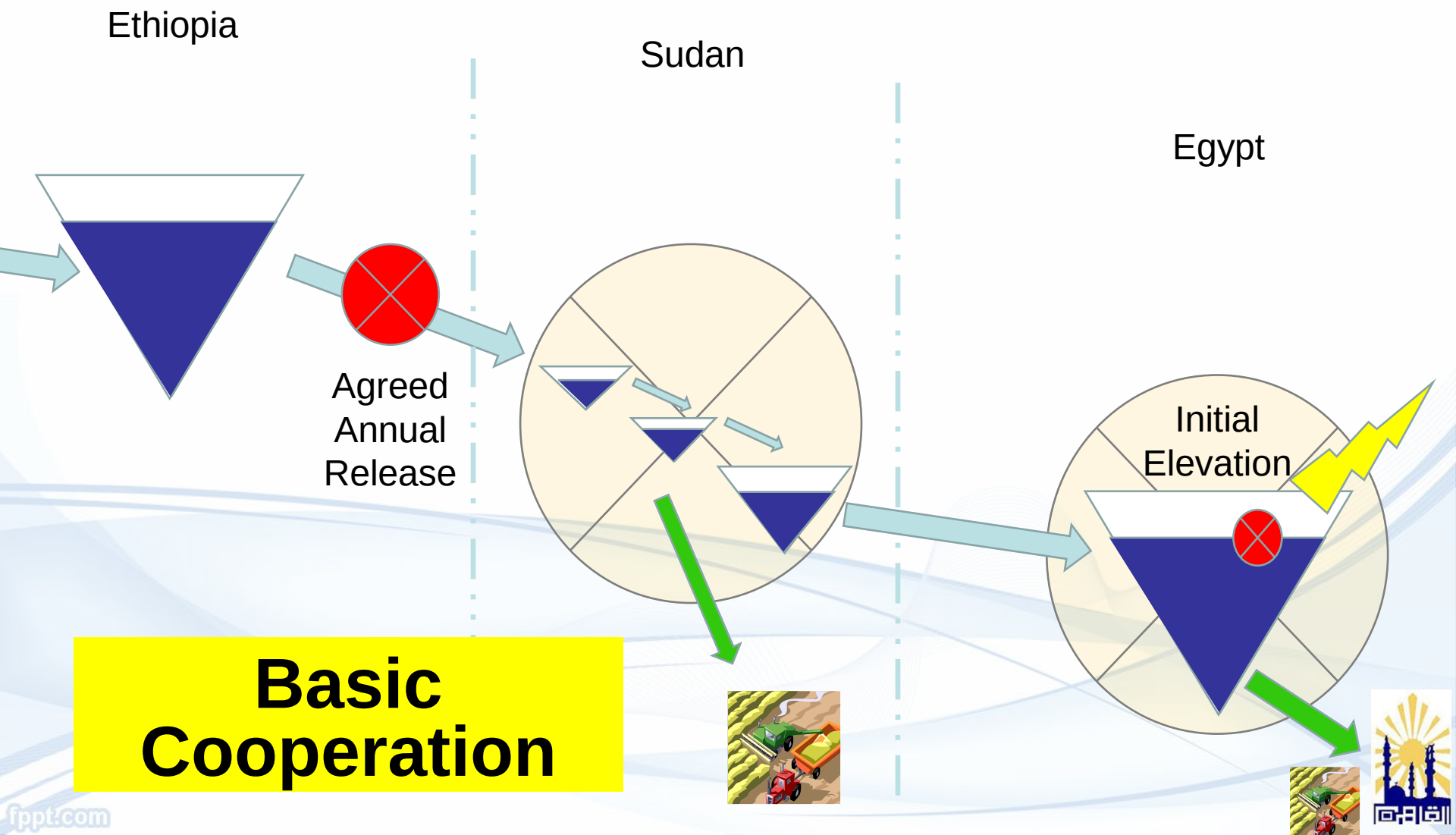
Approach

- 2012 – NBI Consultancy for model development
- 2013-2016 – Joint model development
  - RiverWare Trainings in Egypt, Sudan, Ethiopia




  - Constant refinement through 7 week-long sessions
- 2016 – Test cooperative filling scenarios
  - Disseminate model and results

Many Possible Dimensions



Basic Cooperation

Test Cooperation Mechanisms During Filling

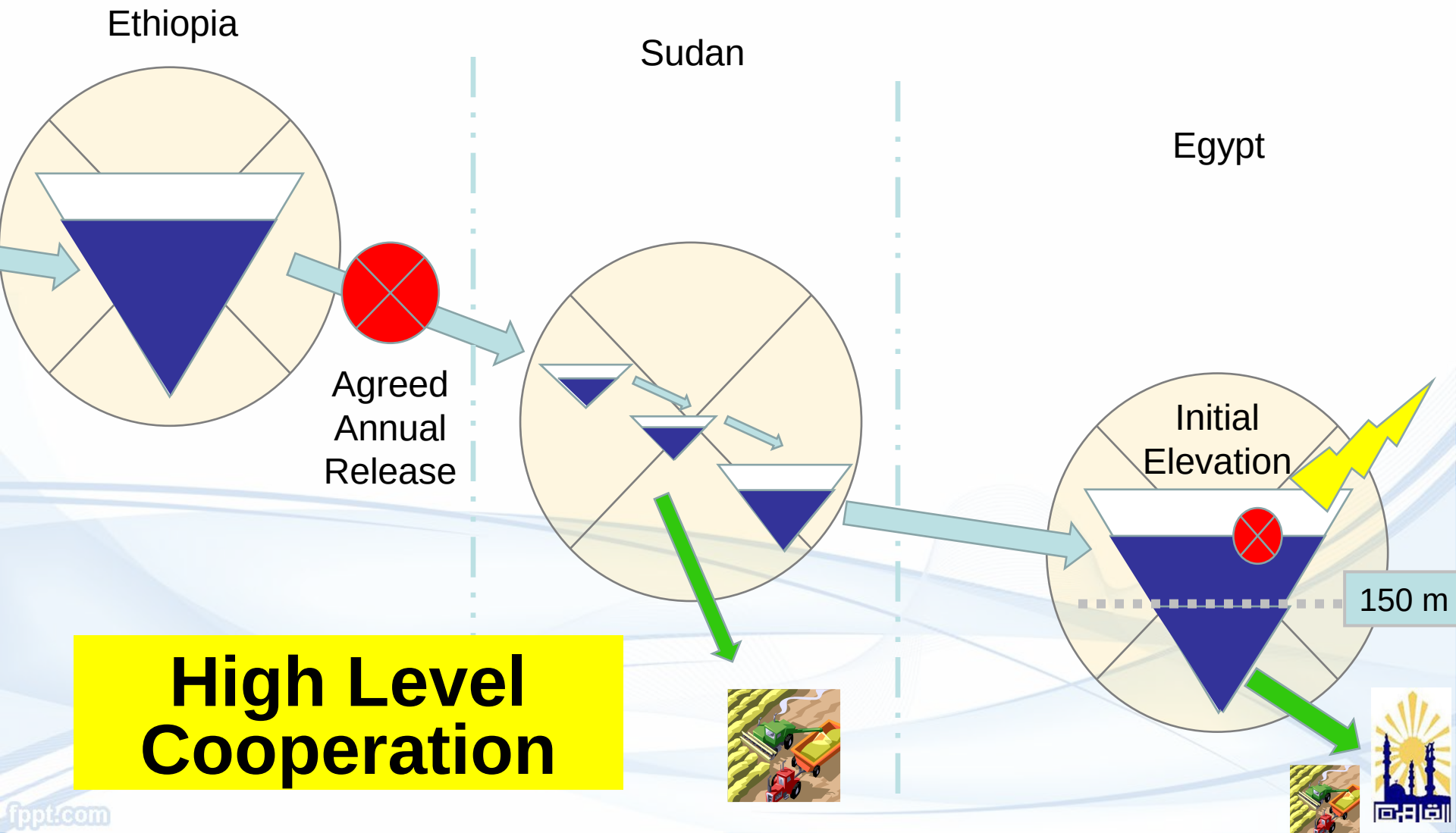
- Agreed annual releases from the GERD (0 to 50 BCM)
- Starting elevation of the High Aswan Dam (165 to 180m)
- Operations of the High Aswan Dam
- Operations of the Sudanese reservoirs

Probability of Critical Egypt Hydropower Failure

(a) With GERD

		Initial HAD Elevations			
		180m	175m	170m	165m
Baseline - No GERD		**0%**	**0%**	**0%**	**0%**
GERD Agreed Annual Release	50 BCM	**3%**	**4%**	**6%**	**10%**
	45 BCM	**3%**	**4%**	**6%**	**11%**
	40 BCM	**5%**	**6%**	**7%**	**13%**
	35 BCM	**7%**	**9%**	**15%**	**31%**
	30 BCM	**7%**	**9%**	**21%**	**45%**
	25 BCM	**8%**	**9%**	**27%**	**47%**
	0 BCM	**2%**	**7%**	**17%**	**37%**

Many Possible Dimensions



High Level Cooperation

Probability of Critical Egypt Hydropower Failure

		(a) With GERD				(b) With GERD + High Aswan Dam Drought Operations			
		Initial HAD Elevations				Initial HAD Elevations			
		180m	175m	170m	165m	180m	175m	170m	165m
Baseline - No GERD		0%	0%	0%	0%	0%	0%	0%	0%
GERD Agreed Annual Release	50 BCM	3%	4%	6%	10%	0%	0%	0%	2%
	45 BCM	3%	4%	6%	11%	0%	0%	0%	3%
	40 BCM	5%	6%	7%	13%	0%	0%	0%	5%
	35 BCM	7%	9%	15%	31%	1%	1%	3%	6%
	30 BCM	7%	9%	21%	45%	4%	5%	6%	11%
	25 BCM	8%	9%	27%	47%	6%	7%	9%	18%
	0 BCM	2%	7%	17%	37%	1%	3%	10%	20%

Nile Basin: Emerging Outcomes

- High level trust still lacking
- Formal data sharing lacking
- A lot of interest to
  - Get beyond the hyperbole
  - Find a middle ground
- Over-reliance on outside expertise
- Need flexible internal analytical tools
- Time for ‘Horse-Trading’ is running out

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Recent Publication

Cooperative filling approaches for the Grand Ethiopian Renaissance Dam

Kevin G. Wheeler, Mohammed Basheer, Zelalem T. Mekonnen, Sami O. Eltoum, Azeb Mersha, Gamal M. Abdo, Edith A. Zagona, Jim W. Hall, Simon J. Dadson

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